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ABSTRACT

This study was designed to identify variables which account for successful performance in a remedial community college mathematics laboratory. Mathematics pretest scores, mathematics skills test scores, attendance time, age, gender, and attitude were used to help predict achievement. The sample consisted of the total population in the mathematics laboratory during the fall of 1987 (247 students) and 1988 (233 students). Gender, time of attendance (day or evening), and attitude were shown to be independent of the variable grade. The regression equation found the pretests, age, and the mathematics skill test were significant in predicting students' final grades and accounted for 31 percent of the variance. Ten references are listed. (YP)

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CHARACTERISTICS RELATED TO STUDENT PERFORMANCE IN A COLLEGE REMEDIAL SELF-PACED MATHEMATICS LABORATORY

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Abstract

This study was designed to identify variables which account for the successful performance in a remedial community college mathematics laboratory. A general statistical model will be developed from this information to predict student success.

Mathematics pretest variables, gender, attendance time-of-day, attitude, and age were used to help predict achievement (grades).

The sample consisted of the total population in Lake Michigan College's remedial mathematics lab during the fall of 1987 and 1988. 247 students from the fall of 1987 and 233 students from the fall of 1988 participated in the study.

Gender, time of attendance (day or evening), and attitude were shown to be independent of the variable grade. The regression equation found the pretests dealing with whole numbers, ratios & proportions, and algebra along with age and the asset test were significant in predicting student's math grades with an R square of 31%.

CHARACTERISTICS RELATED TO STUDENT PERFORMANCE IN A COMMUNITY COLLEGE REMEDIAL SELF-PACED MATHEMATICS LABORATORY

Introduction

The purpose of this investigation is to identify factors that contribute to student success in remedial basic mathematics courses. Nationally, colleges report that it is not uncommon to experience attrition rates ranging from 25% to 65% and that two-year colleges are likely to experience the highest and most sustained attrition rates (Jones,1986). It has also been found that 32% of the four-year college students need help in remedial mathematics and 39% in two-year programs (Plisko & Stern, 1985). Results of the 1984 New Jersey Basic Skills Test indicated that 70% of its incoming students need remediation in basic computational skills in mathematics (Wepner, 1985). In a 1977 study in El Paso Community College it was found that 98% of its students needed remedial mathematics (Rounds & Anderson, 1985).

Clearly something must be done to identify and help these students. These students are underprepared for college programs. They are the nontraditional college students who took little, if any, college prep. courses in high school. Many didn't anticipate going to college, while others are older students returning to school for various reasons.

These students have not retained the needed skills for college, or they were never learned.

The focus of this study is to explore the plausibility of developing a model for academic achievement. This will assist in singling out potential unsuccessful students; thus, giving counselors the ability to identify and closely supervise these students.

Variables

Independent: For this study variables were used that were easily measured and readily available. Much of this information is normally available on all entering college students; therefore, making it economically practical and efficient for the college to use.

The variables (characteristics) used for prediction in this study were: student's age, attitude, time-of-day attending (day or evening classes), gender, pretest scores, asset test (Assessment of Skills for Successful Entry and Transfer) scores, and the amount of time (hours) spent in the classroom during the semester.

Dependent: The dependent variable for this study is the academic proficiency (grade) of the student in the remedial basic mathematics course. For the purpose of this study successful completion will be defined as a grade of an 'A', 'B', or 'C', and nonsuccessful completion is the grade of an

'D', 'E', or 'W'.

The semester exam has ten questions from each of six units. For an "A", the students must achieve 80% mastery in each of the six units on the first try. If this is not attained the students have a second chance for a "B". If this is not achieved, the students receive the grade of a "C" for successfully completing all subunit tests with the grade of an 80% or higher during the course. If only five units are completed, then the grade of a "D" is given. The rest of the students are given withdrawals, no "E's" are given unless asked for by the students. These nonsuccessful students will again register and start the course from the beginning. This will help in reinforcing the math skills not retained in the prior class. The withdrawal "W" does not effect the student's G.P.A. With proper counseling from the teachers, the students will not become discouraged, but rather encouraged to retake and successfully complete the course.

Methods

Subjects: Lake Michigan College (L.M.C.) is a forty year old community college located in Southwestern Michigan. The area is composed of rural agriculture and urban industry. In the immediate area is the worlds largest fruit market and 170 industrial firms. The college has an enrollment of approximately 4,000 students in

more than 100 programs. To meet the educational needs of this community L.M.C. has an "open door" admissions policy (Lake Michigan College, 1989). At L.M.C., approximately 1,900 students fail to return each year. Some of these transfer to other colleges, some finish two year programs, and others drop out of school entirely. One thousand of these nineteen hundred students (52.6%) have grade point averages below 2.0. These are the academically unsuccessful students. This data is not inconsistent with other colleges in the United States. If this model helps recognize these students, then these students can be more closely monitored. 247 Basic Math. Lab. students were used in this study. This was the total population of the L.M.C. Math Lab in the Fall of 1987. In the Fall of 1988, another 237 students similarly participated in this longitudinal study. These two groups comprised students (male and female) 17 years and older who may or may not have a high school degree. These are generally the nontraditional college student who had never considered going to college a few years earlier. They are generally weak in reading, writing, and mathematical skills, and these students have not retained the needed skills for college; in a few cases these skills were probably not learned and retained.

Instrumentation: All students entering L.M.C. are required to take a nationally normed reference placement test (Asset

test) developed by the American College Testing Program (ACT). Students entering basic math courses are also required to take a criterion referenced placement test that was developed by Dr. Joanna S. Burris and Harper & Row Publishing Company for the Basic Mathematics: An Individualized Approach series (Burris, 1981). These are the pretests that were administered to the students. As the students finished the math lab program a posttest (a second version of the criterion referenced test) was used to evaluate their progress through the various sections of the program and help determine the grade. During the month of November 1988 students were given a math attitude test. This was the Aiken-Dreger "Mathematics Attitude Test" with a five option Likert-type scale with ten reversals on twenty questions. This test was short in length and easily administered with minimal disruption in the class. Aikens (1976) suggests that there exists a relationship between attitude and achievement. This correlation he suggests is in the range $r = .20$ to $r = .40$. The variables age and gender were attained from the admissions records office of the college. The amount of time the students spend in the lab is closely monitored. The students must punch a time clock when entering and leaving the room. These will be helpful in ascertaining some important characteristics of the math lab students.

Procedures: Entering college students must fill out a registration form which includes information on birth date (which can easily be used to calculate age) and gender (1 = male, 2 = female). Also starting with the fall 1988 all students are required to take a normed referenced entrance test (ASSET) for correct placement by the counselors into various programs. In the fall 1987 the asset test was given the students as they finished the course, this was done to establish a cut off score for this test. The basic mathematics section has 32 questions on this test; the number of correct responses were recorded. Once it is determined that the students need remedial mathematics (from the asset test), they are placed in the basic mathematics 090 laboratory courses. Upon entering this course, the students are given a criterion referenced test which is directly related to the instructional goal and objectives in the mathematics lab course; this determines the areas of strengths and weaknesses of the students. Multiple forms of this test were developed by Dr. Joanna S. Burris for this particular program. The test is divided into seven sections with ten questions per section; the number wrong in each section was recorded.

This course is an audio-tutorial self-paced fundamental mathematics class. The students in this course are taught

concepts in whole numbers, fractions, decimals, ratios and proportions, percentages, and some simple geometry or algebra concepts. The criterion referenced pretest covers all these seven sections. This course generally takes most students one semester to finish. Since the course is self-paced, many students finish early, since much of this course is review. A few take more than one semester to finish, apparently this material was never retained or learned. The amount of time the students spend in the lab is closely monitored. The students must punch a time clock when entering and leaving the room. With this a teacher can closely monitor attendance. The time was totaled for each student and approximately 55 minutes was equated to one period. Once a student is seated, they are in open modular booths with headphones on. The headsets serve a dual purpose. One is to minimize distractions and hold student attention, the other is, the textbook is read by the use of an audio tape to the students and the examples are explained. Many of these students also have reading deficiencies which the audio tape helps overcome. Students may also duplicate tapes for home use.

During the month of November 1987 students were given a math attitude test. This was the Aiken-Dreger "mathematics Attitude Test" with a five option Likert-type scale with ten reversals on twenty questions. This test was short in length and easily administered with a minimal disruption in the

class. Aikens (1976) suggests that there exists a relationship between attitude and achievement. This correlation is in the range r = .20 to r = .40. The student score on this 80 point test was recorded.

All of these variables were used for the first group and collected in Dec. 1987. In Feb. 1988 the data was coded into an IBM-PC computer. Variables for the second group (Fall 1988) excluded the Attitude characteristic and were coded into the computer in the spring of 1989. Statistical Analysis using alpha = .05 and SPSS (Statistical Packages for the Social Sciences) was used to alter the data into a more usable form. "A Guide for Selecting Statistical Techniques for Analyzing Social Science Data" published by the Institute for Social research at the University of Michigan was used to ensure that proper statistical procedures were followed.

Results:

After examining the student records the average age of the day and evening students were calculated for the 1987 and 1988 fall classes of 090 Basic Mathematics. The average for the 1987 class was 24 years (day 23 years and evening 26 years) and for the 1988 class was 25.4 years (day 25 years and evening 29 years).

Table 1

Frequency distribution of grades
by day and evening.

Fall 1987		Grade A	B	C	D	W	Row Total	Av. GPA
Day	Count	53	15	57	20	49	194	2.02
	Percent	27.3%	7.7%	29.4%	10.3%	25.3%	78.3%	
Evening	Count	13	4	15	9	12	53	1.94
	Percent	24.5%	7.5%	28.3%	17.0%	22.6%	21.5%	
Column Totals		66	19	72	29	61	247	2.00
% of total		26.7%	7.7%	29.1%	11.7%	24.7%	100%	

Test		D.F.	Significance
Chi-Sq. =	1.8348	4	.7664
t-test =	.31	245	.758 (2 - tailed pooled variance)

Fall 1988		Grade A	B	C	D	W	Row Total	Av. GPA
Day	Count	50	9	51	24	53	187	1.88
	Percent	26.7%	4.8%	27.3%	12.8%	28.3%	80.3%	
Evening	Count	17	6	9	4	10	46	2.35
	Percent	37.0%	13.0%	19.6%	8.7%	12.4%	19.7%	
Column Totals		67	15	60	28	63	233	1.98
% of total		28.8%	6.4%	25.8%	12.0%	27.0%	100%	

Test		D.F.	Significance
Chi-Sq. =	7.19868	4	.1258
T-test =	-1.80	231	.073 (2 - tailed pooled variance)

The Chi-Square statistics in table 1 indicates grades and time in attendance (day or evening) are independent variables. The t-test with its large level of significance indicates there is no difference between the groups of evening and day students with respect to grades. Also there seems to be approximately a four to one ratio

between the number of students taking the day and evening classes.

The column grade percentages for the two years are very similar; From this table one can note the close magnitude of the number of 'A' and 'W' students for each of these years. Approximately one fourth of the class gets A's and W's. 63.5% (1987) and 61% (1988) successfully completed the course with a 'C' or better, while 36.4% (1987) and 39% (1988) failed to do so. These are approximately trimodel grade frequency distributions.

Table 2

Grades of students repeating the program for the second semester

	Grades				
	A	B	C	D	W
Fall 1987	0	0	0	2	3
Fall 1988	2	1	2	2	4

In table 2 the fall 1988 students really repeated the class in the winter of 1988 (the following semester), while the fall 1987 students were repeating the class that term (fall 1988). There seems to be a difference between the two semesters in grades of repeating students. However, it should be noted that there are not really enough students to make any statistical inferences.

With the large number of nonsuccessful students during

these two years, the above table may seem trivial. However, during the gathering of data for table 2, it was found the some 'D' students were continuing into the elementary algebra course.

Table 3

Grades by days present (1 day = 55 min.)

	Grades				
Fall 1987	A	B	C	D	W
Days Present					
Mean	21.3	27.3	25.8	18.4	12
Median	18	25	22.5	16.5	7
Mode	15	10	11	12	3
Fall 1988	A	B	C	D	W
Days Present					
Mean	30.2	33.9	30.5	31.1	15.3
Median	28.0	30.0	25.0	24.0	11.0
Mode	40.0	38.0	22.0	6.0	1.0

Time spent in the lab increased from the fall of '87 to the fall of '88 in all categories except the mode of the 'W' column. Normal credit hour attendance for this class would be 60 hours. The 'B' students generally spend more time in the lab than the other students. No student group spends the allotted 60 semester hours in this course.

Table 4

Grade by gender

Fall 1987

	A	B	C	D	W	Total
Male	22	7	29	8	28	94
Female	44	12	43	21	33	153

Test		D.F.	Significance
Chi-sq.	= 3.72838	4	.4440
T-test	= -1.13	245	.258

Fall 1988

	A	B	C	D	W	Total
Male	17	3	20	8	22	70
Female	50	12	40	19	38	159

Test		D.F	Significance
Chi-sq.	= 2.92010	4	.5713
T-test	= -1.45	227	.150

Table 4 shows the ratio of women to men in these two semesters is approximately two to one (312 to 164). The large numbers in the significance indicates that grade wise the two genders are not dissimilar and grade mean is independent of gender. In other words sex has no influence on grades received. A closer investigation of the ratio of women to men indicated an approximate 2:1 ratio, except for the evening 1988 class which had a ratio of 1.3:1.

The Aiken-Dreger Math Attitude Test was given in late November 1987. Only 49 students took this test (many students were not in the math lab at this time). Analysis of variance found that attitudes had no effect on grades. However, the Aiken-Dreger Test did indicate that the students were "not scared" nor "strained in math classes" but had a good feeling toward mathematics. It was not a dreaded

subject in which they "felt lost in a jungle." However, they "did not find the subject stimulating nor did they greatly enjoy taking the course."

Table 5
Backwards regression (1988 class) for successful Completion

Multiple R	.55779
R Square	.31113
Adjusted R Square	.28118
Standard Error	.79373

Analysis of Variance

	D.F.	Sum of Squares	Mean Square
Regression	5	32.72250	6.54450
Residual	115	72.45105	.63001

F = 10.38794 Significance F = .0000

Variables in the Equation

Variable	B	Sig T
Asset	.04254	.0164
Age	.03978	.0003
Pretest1 (Whole numbers)	-.13556	.0194
Pretest4 (Ratios & Prop)	-.10795	.0548
Pretest7 (Algebra)	-.11259	.0126
(Constant)	2.98090	.0000

Equation:

Grade = .04254Asset + .03978Age -.13556Pretest1 -
.10795Pretest4 -.11259Pretest7 + 4.18846

95% Confidence Interval (B's)

Asset	7.949037E-04	.07712
Age	.01885	.06072
Pretest1	-.24880	-.22310
Pretest4	-.21815	-2.243366E-03
Pretest7	-.20060	-.02458
Constant	1.88580	4.07600

A backwards regression (table 5) was used to find how the characteristics (variables) related to successful

completion. All the pretest variables were used (asset, whole numbers, fractions, decimals, ratios & proportions, percentages, simple geometry, intro-algebra) along with gender and age. A stepwise regression had the same results. The variables that remained in the fall 1988 backwards regression are shown in table 5. The coefficients for the pretests are negative, but these scores represent the number wrong in each section of the pretests. So the higher score implies more problems have been missed. The lower the score the more problems the students have correct. The model accounts for 31% of the total variance.

A 95% confidence interval shows where most of the successful group resides in the general population. 95% of this group lies in this region.

A similar regression was run on the non-successful students; however, only 12% of the variance was accounted for. The only significant variable left after a backwards regression with this group was the asset test score.

An interesting note: when the reading and English scores of the asset test were included in the regression runs, the outcome didn't change.

Conclusion: This investigation was designed to investigate the factors that contribute to the successful completion of remedial college math students and develop a model for

student achievement.

It was found that neither the gender of the students nor the time of day they attended class had any effect on the students grade. Sex had no apparent affect on the grade.

It should be noted that gender was not equally balanced in this course. There were almost twice as many women taking the class as men. The average age of the population was approximately 25 years old. The older students are out in the work force and attend school in the evening. This is shown by the increased age of students in the evening classes. It's interesting that the number of women out number the men in all session (day and evening). Perhaps the women feel education is necessary for upward mobility in the work place.

The average grade for the two different semesters was 2.00 (1987) and 1.98 (1988). During these semesters the day and evening classes had averages of 2.02 and 1.94 (1987) , 1.88 and 2.35 (1988). In 1987 the day class had a higher average but in 1988 the evening class had the higher grade average. However, neither section (day or evening) were statistically different with respect to the grades given. If students attended the day or evening classes had no apparent effect on their grades.

The multiple regression model developed had an R square of approximately 31%. This model predicts about one third of

the variance in grades. Much of this unexplained variance may be in the form of mediating or extraneous variables that are beyond the control of any institution. Such as, corporations moving or changing employees schedules, making attendance impossible. Still other students may have family or health related problems. Single mothers seem to have trouble with sick children and finding a sitter or day-care for their children.

The 95% confidence interval, for the regression model, was used to sort out possible successful students from the non-successful students. Since 95% of the successful students lie in this region, it was hoped that the students outside this region could be closely monitored and retention greatly increased.

While a large percentage of students are succeeding in the mathematics lab, still others are not. This may be reflected in their math attitude. Roueche (1987) found that these students have unrealistic expectations. They are not after skills to help with a future career but simply self-esteem, which quickly petered out. These students are out of high school and after playing or working all summer long, they were ready to do what they have always done - go back to school. They are the students who made poor choices in the past and will continue to make poor judgements. The number of hours spent in the math lab shows the procrastination of

these students in finishing the task at hand. Many played around in the K-12 system and intend to do the same at the college level. As a result they attend class a very few hours during the semester. Notice the mode in hours attended for the 'W' students; in 1987 three hours and in 1988 one hour was spent by most students in this group. This is not an isolated problem at this institution but at many others as well. No matter what teaching method is used, the problem of time spent on task still persists. Somehow, these students must be encouraged to spend more time in the lab and learn the material.

The amount of time spent in the lab by the 'A', 'B', and 'C' students reflects the fact that many in this group of students needed only a mathematics refresher and quickly finished. This was the main purpose for having the math lab. These students did much of their work at home and accordingly spent only enough time in the lab to take the required tests. The D's and W's procrastinated and did not spend enough time on task to learn this material. Since little time was spent on task, little was gained. However, some 'D' students did continue onward into the elementary algebra course. This was an interesting discovery. It was possible since the students did finish the basic math sections of the course successfully (achieved 80% or higher on all the subunit tests).

It might be recommended that those students entering the math lab without the multiplication or addition skills perhaps, be allowed to use a calculator. If the addition and multiplication facts were not learned in the 12 years of the K-12 system, it may be an act of futility to think they can be taught this concept in one or two semesters. Allowing these students into college may be questionable. However, since they are there, the mathematics lab may need to permit some device (a calculator) that may allow the students a chance to succeed.

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